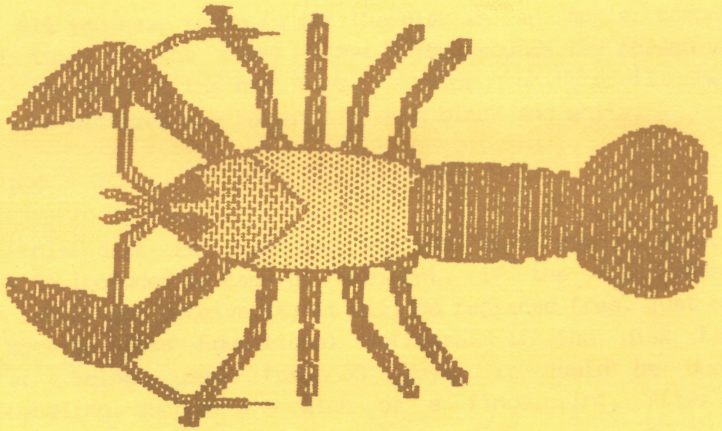
APPLE

COMPUTER BIOLOGY LAB

CRAYFISH DISSECTION

By Larry Newby



CROSS EDUCATIONAL SOFTWARE

CRAYFISH DISSECTION

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INTRODUCTION

"CRAYFISH DISSECTION" can be used as a pre-lab or post-lab computer activity. It gives instructions and definitions that a student should know before entering the lab. After a dissection the program can be used as a self-test. The reading level and content are meant for seventh and tenth grade biology students.

GETTING STARTED

All you have to do is put the disk in an Apple computer and turn on the power. After a few seconds the screen will show the menu on the next page. A color monitor will help, but the pictures are compatible with black and white.

COPIES

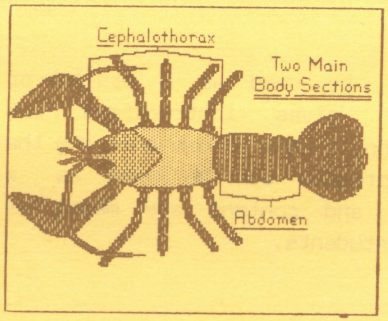
This disk is protected against being copied. A backup disk is included in case of accident. If the disk doesn't run when you receive it, it will be replaced free. Just mail it back to Cross Educational Software. If the disk fails after being used for 30 days, it could be due to mishandling, such as a scratch or a fingerprint. After 30 days there is a $6 charge to replace a disk.

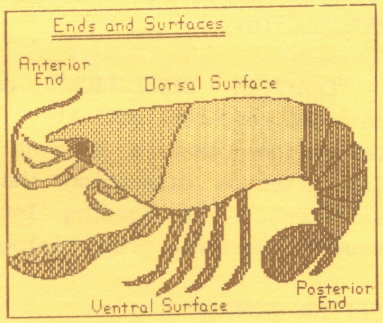
MANUAL AND TESTS

The following pages are a summary of the program. The test pages can be duplicated and given to students if there isn't enough time for all students to run the program during class.

MAIN MENU

1) ORIENTATION
2) STRUCTURES AND FUNCTIONS
3) SELF TEST
4) STUDENT CONTROLLED DISSECTION





1) ORIENTATION: VOCABULARY LIST

ABDOMEN	EXOSKELETON	OVARY
ANTENNA	GANGLIA	OVIDUCT
ANTENNULE	GILL	PINCER
ANTERIOR	GREEN GLAND	POSTERIOR
ARTHROPOD	HEART	PERICARDIUM
BRAIN	INTESTINE	PYLORIC STOMACH
CARAPACE	INVERTEBRATE	SPERM DUCT
CARDIAC STOMACH	MANDIBLE	STERNAL ARTERY
CEPHALOTHORAX	MAXILLA	SWIMMERET
CHITIN	MAXILLIPED	TELSON
CRUSTACEAN	MOLT	TESTIS
DIGESTIVE GLAND	MOUTH	UROPOD
DORSAL	NERVE CORD	VENTRAL
DORSAL ARTERY	OMNIVORE	VENTRAL ARTERY
ESOPHAGUS	OPEN SYSTEM	WALKING LEG
EYE	OSTIUM	

GENERAL BACKGROUND

The crayfish is an arthropod. This means it is an invertebrate (it has no backbone), it has jointed legs, and has an exoskeleton (hard outer covering) made of chitin. It is also a crustacean which means it has two body divisions (cephalothorax and abdomen) and five or more pairs of appendages.

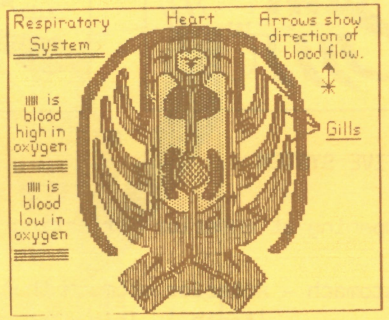
Since the crayfish has an exoskeleton, it must molt or shed its hard covering in order to grow. Several times a year the crayfish may crawl out of his hard shell and go into hiding. During the next few hours the crayfish is totally defenseless until his new exoskeleton hardens.

The crayfish is an omnivore. It will eat both plant and animal matter. It is a solitary creature that hides under rocks and in crevices.

The crayfish can move forward or sideways by using its walking legs and backward very quickly by using its abdomen.

2) DEFINITIONS OF STRUCTURES

A) RESPIRATORY SYSTEM



Gills - Breathing structures in crayfish that exchange oxygen and carbon dioxide.

Oxygen Rich Blood - Blood that has a high oxygen content and relatively low carbon dioxide content.

Oxygen Poor Blood - Blood that is high in carbon dioxide and relatively low in oxygen.

Open Circulatory System - A circulatory system in which the blood is not always contained within vessels.

B) CIRCULATORY SYSTEM

Heart - Organ responsible for pumping blood around body.

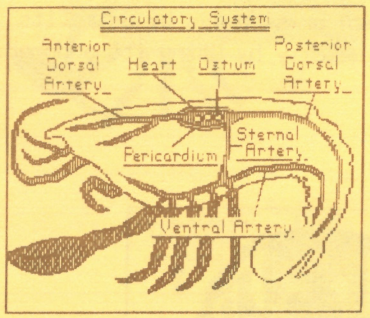
Ostia - (ostium--singular) Tiny openings in the heart that function as valves.

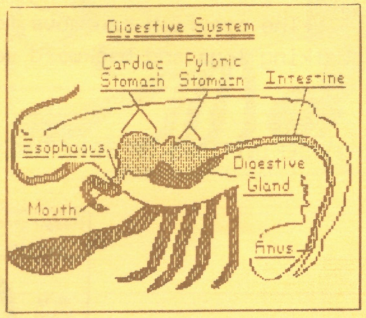
Pericardium - Sac-like structure enclosing the heart.

Dorsal Artery - Main artery running along the dorsal surface.

Sternal Artery - Main artery connecting heart with ventral blood vessels.

Ventral Artery - Main artery running along the ventral surface.





C) DIGESTIVE SYSTEM

Mouth - Opening at anterior for eating food.

Cardiac stomach - Anterior stomach that contains chitinous 'teeth.' This stomach grinds food.

Pyloric Stomach - Posterior stomach that contains filters for catching wastes and undigestible food.

Esophagus - Tube that carries food from the mouth to the stomach.

Intestine - Area where undigested food is stored.

Digestive Gland - Organ that secretes digestive enzymes and stores fat, glycogen, and calcium.

Anus - Opening at posterior that is used for the elimination of waste.

D) HEAD AND MOUTH PARTS

Antenna - (antennae--plural) Sensory organ used for touch and taste.

Eye - Compound eyes.
Produce mosaic or multiple images for the crayfish.

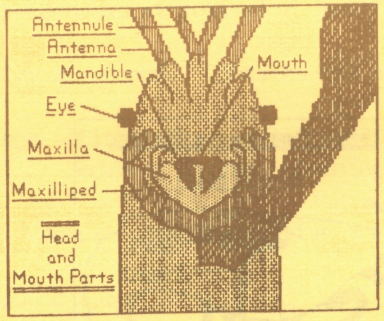
Antennule - Sensory organs used to touch, taste, and balance.

Mandible - Mouth part used to bite food. Closest to mouth.

Maxilla - (maxillae--plural) Mouth part located outside of mandibles. Used for handling food.

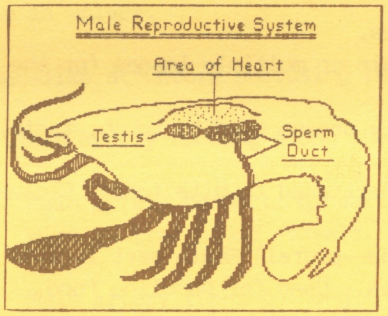
Maxilliped - Largest and outermost mouth part. Used for touching, tasting, and handling food.

Mouth - Opening at anterior for eating food.



E) REPRODUCTIVE SYSTEM

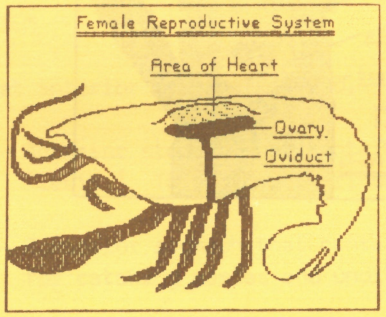
MALE



Testis (plural--testes) - Produces sperm cells in the male.

Sperm Duct - carries sperm cells during mating process.

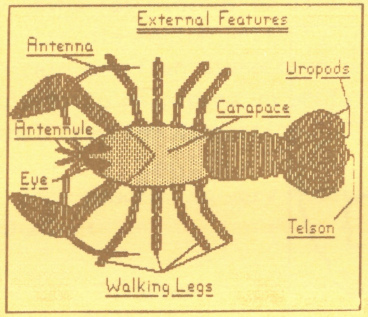
FEMALE

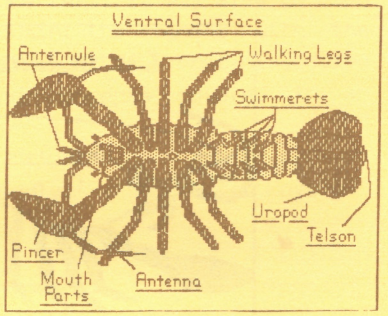


Ovary - Produces egg cells in female.

Oviduct - Passageway for eggs to outside of female's body.

F) EXTERNAL FEATURES





Antenna - (antennae-plural) Contains nerve endings which help in touch and taste.

Antennule - Sensory organ used for touch, taste, and balance.

Uropod - Appendages at posterior used for swimming.

Telson - Center uropod. Contains the anus of the crayfish.

Walking Legs - Eight attached to cephalothorax. Used for moving, mating, cleaning body, and breathing.

Carapace - (dorsal view) Protective shell of cephalothorax.

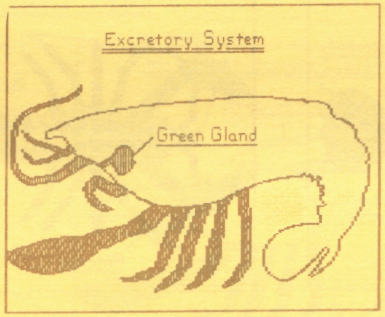
Eye - Compound eye.
Produces mosaic or multiple images in crayfish.

Swimmerets - (ventral view) Abdominal appendages which aid in breathing and carry the female's eggs.

Pincer - (ventral view) Large leg at the anterior used for defense and offense.

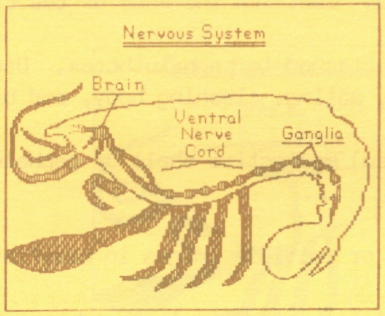
Mouth Parts - (ventral view) Appendages used by the crayfish for eating.

G) EXCRETORY SYSTEM



Green Gland - Removes organic waste from the blood.
Located at anterior.

H) NERVOUS SYSTEM



Brain - Enlarged ganglion at the anterior end of the crayfish.

Ganglion - (ganglia-plural) group of nerve cells which controls nearby body parts.

Nerve cord - Cord running along the ventral surface. Connects ganglia.

GUIDELINES FOR A CRAYFISH DISSECTION

The following dissection may be used in conjunction with any type of biology or life science text. It may also be used as a pre-dissection activity to acquaint the student with the general crayfish dissection guidelines or as a post-dissection activity to reinforce vocabulary and concepts covered in an actual crayfish dissection.

This program is very 'user friendly.' It uses few keys including:

<==	LEFT ARROW KEY	(Back up a page.)
==>	RIGHT ARROW KEY	(Go ahead.)
'RTN'	RETURN KEY	(Switch between text and graphics.)
'ESC'	ESCAPE	(Get out.)

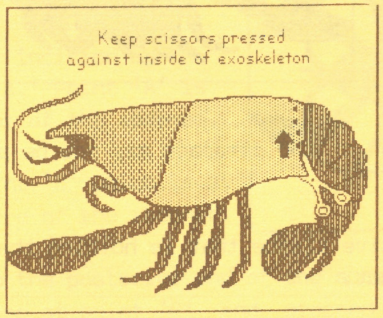
GENERAL DISSECTION GUIDELINES

1) We shall begin this dissection by placing the specimen on its side in the dissecting pan.

2) Carefully insert your scissors under the posterior end of the carapace where it meets the abdomen.

3) Keeping the scissors pressed against the inside of the carapace begin cutting toward the dorsal surface.

4) Continue the incision to about the middle of the dorsal surface.

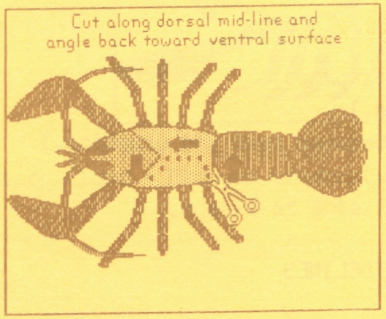


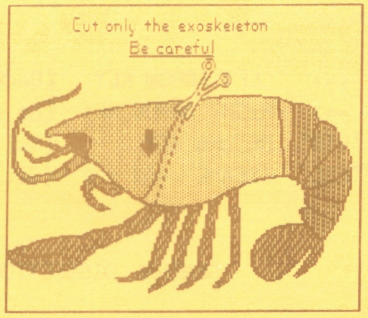
1) Continue the incision along the middle of the dorsal surface toward the anterior (head) of the crayfish.

2) Approximately halfway toward the head begin turning the incision back toward the ventral surface.

3) Be careful so as not to cut any of the underlying structures!

4) Keep the scissors just under the exoskeleton.





1) Cut at a slight angle toward the anterior while moving toward the ventral surface.

2) This incision should end just below and behind the mouth.

1) This section of the carapace may now be peeled away from the body.

2) Any connective tissue that is holding the exoskeleton may be carefully cut.

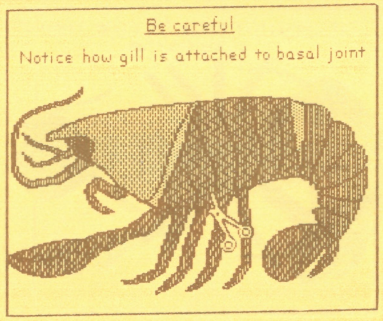
3) You should now be able to see the feathery appearance of the gills.

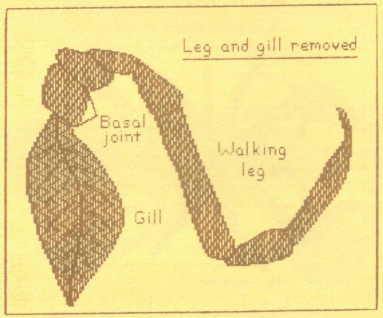
1) We shall now try to remove leg and basal joints from the rest of the exoskeleton without cutting off the attached gills.

2) Find the basal joint of the third leg.
It is attached directly to the rest of the exoskeleton.

3) Using your scissors, carefully cut around the basal joint, being careful not to cut off the gill.

4) This is a somewhat difficult thing to do, so take your time !





1) If you were successful at removing the leg, basal joint, and gill, you should have a structure resembling the one in the picture.

2) This arrangement should give you some idea of why a crayfish moves some of his legs back and forth while he stands still.

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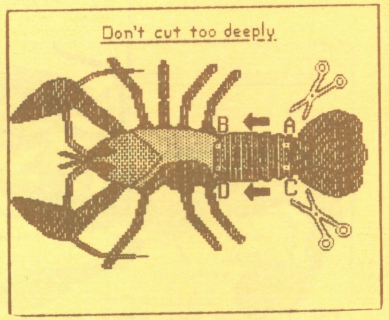
1) We will next remove part of the exoskeleton from the dorsal surface of the abdomen.



2) Start the first incision at the point labeled 'A.' Point 'A' is at the posterior of the abdomen.

3) Cut toward point 'B' which is at the anterior end of the abdomen.

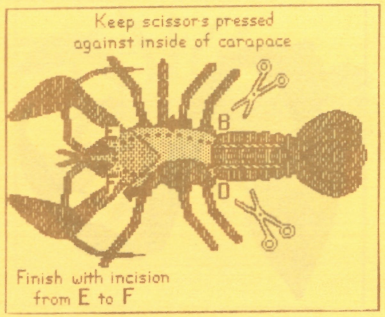
4) Next return to the posterior end of the abdomen and start another incision at point 'C' and proceed in the same manner toward point 'D.'

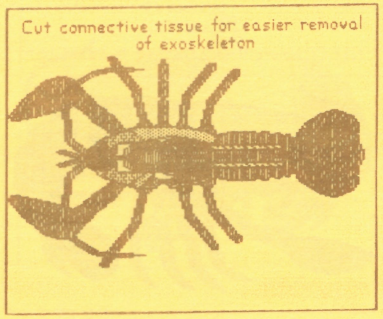
1) Remove the pieces of exoskeleton that you have just cut loose.

2) Now continue the incision from point 'B,' across the carapace, to point 'E.'

3) From point 'D' cut to point 'F.' This will be easier to see since some of the carapace is already missing.

4) You may finish this part by making an incision from point 'E' to point 'F.'





1) Remove this piece of exoskeleton from the carapace, exposing some organs hidden below.

2) If there is any connective tissue holding the exoskeleton, carefully cut it to allow for easier removal.

1) Remove the rest of the walking legs and gills from the left side of the crayfish. Do this in the same manner as you did when you removed the first leg.

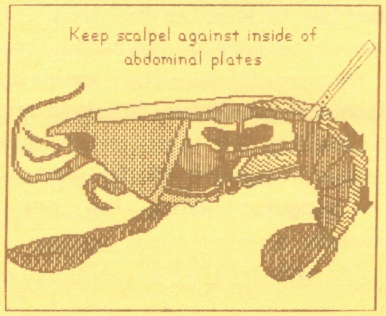
2) Try to keep the gills attached to the basal joints!

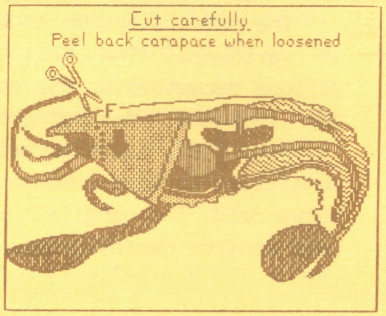
1) Once the legs and gills are removed you can view several organs.

2) Next, insert your scalpel just under the abdominal plates.

3) By moving the scalpel carefully back and forth between the plates and the muscle, you should be able to cut the tissue holding the abdominal plates to the muscle.

4) Once loosened, the plates may be removed.

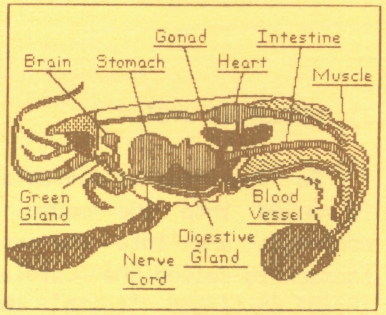




1) Finally, return to the anterior of the crayfish.

2) Make an incision from point 'F' toward the ventral surface.

3) When you get to the area near the mouth, you may begin peeling away this section of the carapace.



1) You may have to remove some muscle and connective tissue to view internal organs and systems.

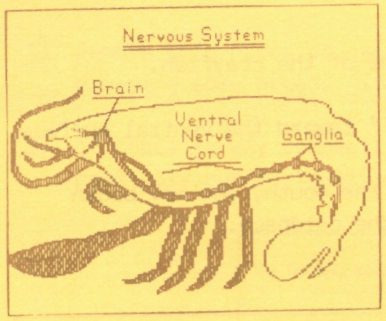
2) Using your specimen, try to find and identify the organs and systems which will be discussed in the next portion of the program.

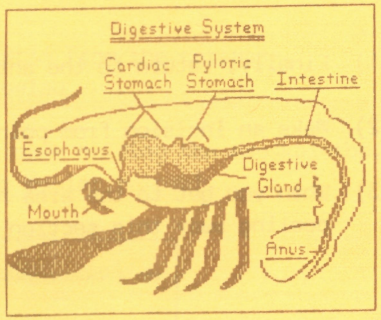
DETAILS OF INTERNAL SYSTEMS

In this section of the program, we shall take a closer look at several of the crayfish 's internal systems and the functions of each. By using your dissected specimen for reference, you should be able to find and identify many of the structures and systems that will be discussed here.

1) NERVOUS SYSTEM

The nervous system of the crayfish is similar to that of an earthworm. The brain is able to receive messages from various receptors on the body of the crayfish. The antenna, for instance, has receptors which are sensitive to odors and flavors. There are also bristles covering the body which are sensitive to touch. Messages are sent by means of the ventral nerve cord. The ganglia (ganglion--singular) along the nerve cord control nearby groups of muscles.





2) DIGESTIVE SYSTEM

As the food is cut up by the action of the mandibles, it is sucked into the mouth. It passes through a short esophagus and into the stomach. The anterior part of the stomach is called the cardiac stomach. This stomach holds three chitinous 'teeth' which grind the food. The food then passes into the posterior or pyloric stomach. This stomach contains bristles which form filters that allow only small particles of food and liquids to pass through.

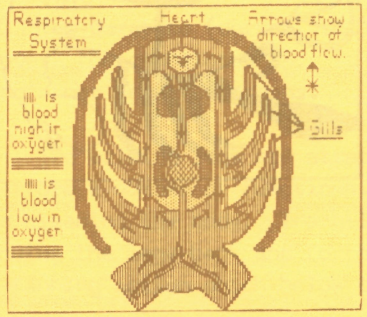
The food particles which pass through the filters are acted upon by enzymes from the digestive gland. Besides secreting enzymes, the digestive gland also stores glycogen, calcium, and fat.

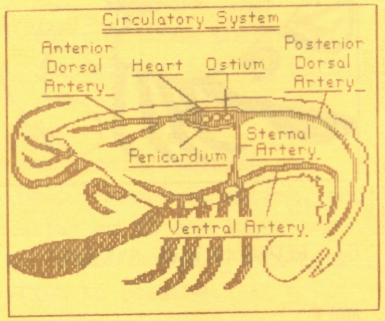
The digested food particles are absorbed into the bloodstream. The larger particles which were filtered out in the pyloric stomach are passed into the intestine where they form feces and are released through the anus.

3) RESPIRATORY SYSTEM

The crayfish is able to get oxygen through its gills. The gills contain hundreds of tiny blood vessels which allow the blood to exchange oxygen and carbon dioxide with the surrounding water. The water passes under the carapace and across the gills. The gills are attached directly to the legs. When the crayfish moves its legs, it creates a fan-like action that helps move the water.

The carapace forms a chamber over the gills which can hold water. This means that the crayfish can live for a short time out of the water.





4) CIRCULATORY SYSTEM

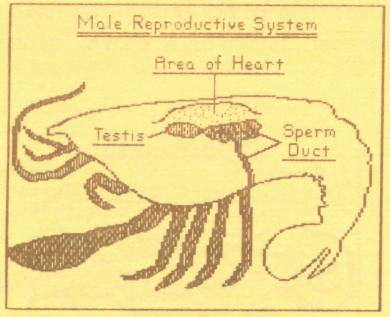
The crayfish has an open circulatory system. This means that the blood is not always contained within the veins or arteries. The heart of the crayfish is held in a sac-like structure called a pericardium. The colorless blood fills the space between the pericardium and the heart. It enters the heart through the openings or valves called ostia (ostium--singular). The blood is pumped out of the heart through the various arteries. (See picture.) The blood

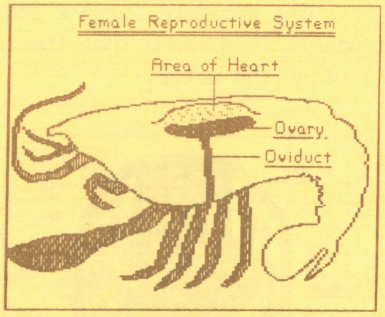
reaches the smaller arteries where it pours over and bathes the internal organs. The blood moves downward and collects in a 'pool' in the thorax. The blood is then drawn up into the veins which carry it to the gills. Here oxygen is picked up and carbon dioxide is released. The blood moves back to the heart, and the process is repeated.

(See also 'RESPIRATORY SYSTEM')

5) EXCRETORY SYSTEM

The green glands make up the excretory system of the crayfish. The green glands are located in the 'head' area just anterior and dorsal to the esophagus. They remove the organic waste from the blood of the crayfish. The green gland is made up of the gland itself and a sac-like storage area. There is a duct which goes from the storage area to an opening near the base of the antenna. The crayfish releases the organic wastes into the water through this opening.





6) REPRODUCTIVE SYSTEM

MALE

The main internal reproductive organ of the male crayfish is the testis (testes--plural). The two small, white testes produce the sperm cells. During mating, the sperm cells pass through the sperm duct and out an opening on the ventral surface near the base of the third set of walking legs.

FEMALE

The main internal reproductive organ of the female crayfish is the ovary. The female crayfish has two ovaries located just ventral to the heart area. They produce the egg cells which pass through the oviduct and out an opening on the ventral surface.

As the eggs are laid, they are fertilized by stored sperm cells and attached to the swimmerets. The swimmerets fan the eggs back and forth to help the water oxygenate them. After the young hatch, they remain attached to the swimmerets for a short period of time before going off on their own.

7) EXTERNAL FEATURES

GENERAL EXTERNAL STRUCTURES

The crayfish has several major external features which can be easily found and identified.

The antenna (antennae--plural) is the longer appendage extending from the head area. It contains receptors which are sensitive to touch and taste.

The antennules are the shorter appendages extending from the head area. They are located between the antennae. The antennules also contain receptors which are sensitive to touch and taste. They also help with balance.

The carapace (dorsal view) is a hard, chitinous shell that covers the cephalothorax. It provides protection for the gills and other internal organs.

The walking legs are attached to the ventral surface and perform a number of functions. They help in moving, mating, and in cleaning the body. The gills are attached to the legs, and by moving the legs back and forth, the gills are moved. This causes a fanning action which helps the crayfish to breathe.

The eye (dorsal view) is a compound eye similar to that of the grasshopper. The images formed are mosaic images. This means that the crayfish does not have very good vision. It is able to see general shapes and movement.

The uropods are the fin-like appendages at the posterior. They aid in swimming and help the female protect her eggs.

The telson is the center uropod.
It contains the anus of the crayfish.

The pincers (ventral view) are the large claw-like appendages found at the anterior. They are used for offensive acts, such as catching and holding food, and defensive acts, such as warding off enemies.

The swimmerets (ventral view) are found on the abdomen. By moving back and forth, they help move water through the carapace. In the female crayfish the swimmerets hold the eggs during the time they are developing.

HEAD/MOUTH PARTS

The anterior or head portion of the crayfish has several parts that should be found and identified.

The antenna (antennae--plural) is the longer appendage extending from the head area. It contains receptors which are sensitive to touch and taste.

The antennules are the shorter appendages extending from the head area. They are located between the antennae. The antennules also contain receptors which are sensitive to touch and taste. They also help with balance.

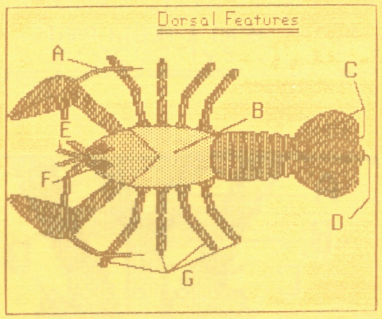
The mouth of the crayfish is found between the mouth parts. It is the opening where food is taken in.

The eye (dorsal view) is a compound eye similar to that of the grasshopper. The images formed are mosaic images. This means that the crayfish does not have very good vision. It is able to see general shapes and movement.

The mandibles are the parts closest to the mouth. They bite the food.

The maxillae (maxilla--singular) are found just outside of the mandibles. They are responsible for handling food.

The maxillipeds are the largest of the mouth parts. They touch, taste, and handle the food. They are the outermost mouth parts.



DORSAL VIEW:

___1) The TELSON is ...

___2) The ANTENNA is ...

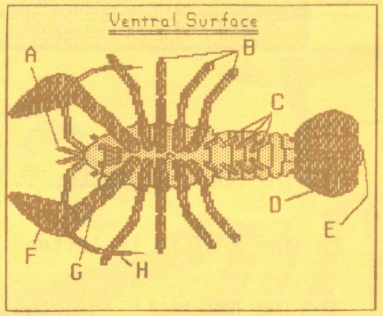
___3) The UROPOD is ...

___4) The EYE is ...

___5) The WALKING LEGS are ...

___6) The CARAPACE is ...

___7) The ANTENNULE is ...



VENTRAL VIEW:

___1) The ANTENNA is ...

___2) The UROPOD is ...

___3) The WALKING LEGS are ...

___4) The PINCER is ...

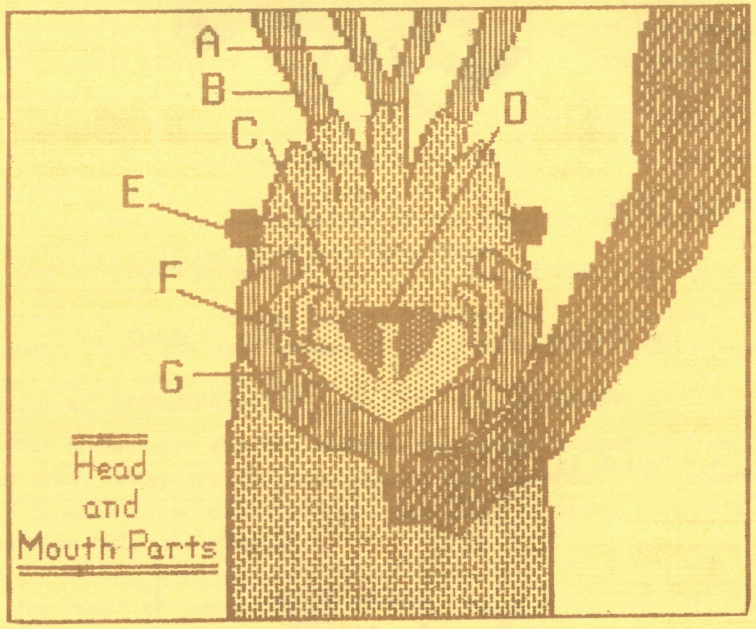
___5) The SWIMMERETS are ...

___6) The TELSON is ...

___7) The ANTENNULE is ...

___8) The MOUTH PARTS are ...

PARTS IDENTIFICATION TEST
HEAD & MOUTH PARTS



___ 1) The MOUTH is letter ...

___ 2) The MAXILLA is letter ...

___ 3) The ANTENNULE is letter ...

___ 4) The EYE is letter ...

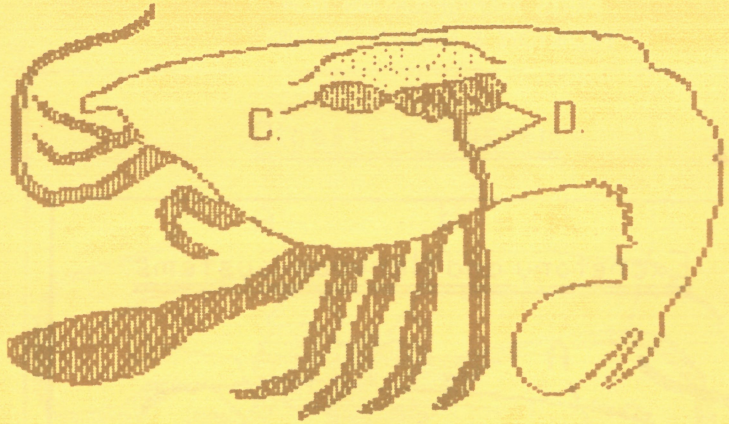
___ 5) The ANTENNA is letter ...

___ 6) The MAXILLIPED is letter ...

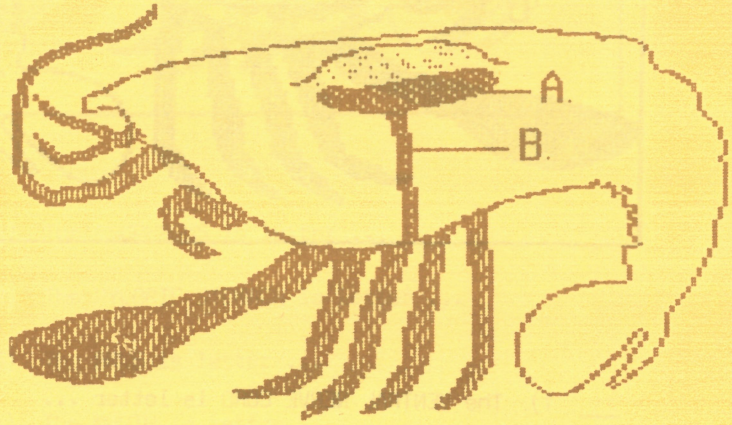
___ 7) The MANDIBLE is letter ...

PARTS IDENTIFICATION TEST
MALE/FEMALE SYSTEMS

Male Reproductive System



Female Reproductive System



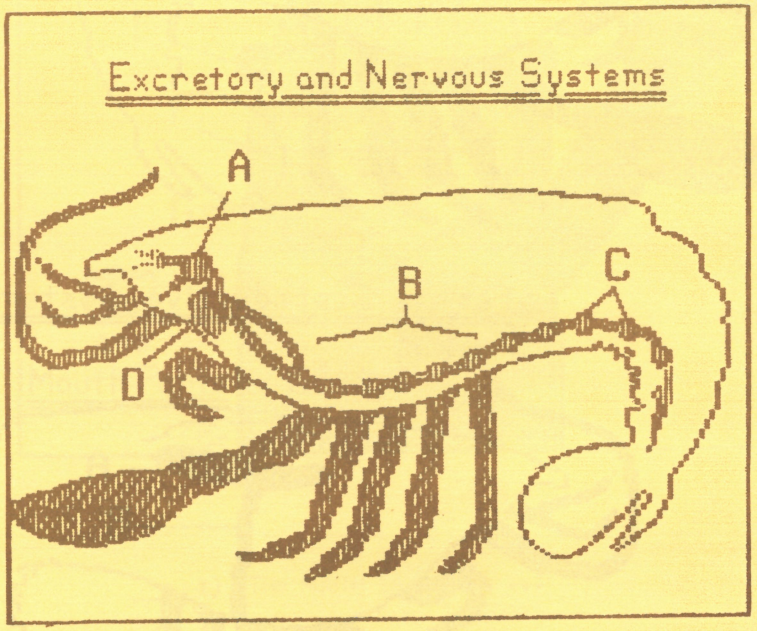
___ 1) The OVIDUCT is letter ...

___ 2) The OVARY is letter ...

___ 3) The SPERM DUCT is letter ...

___ 4) The TESTIS is letter ...

PARTS IDENTIFICATION TEST
EXCRETORY & NERVOUS SYSTEMS



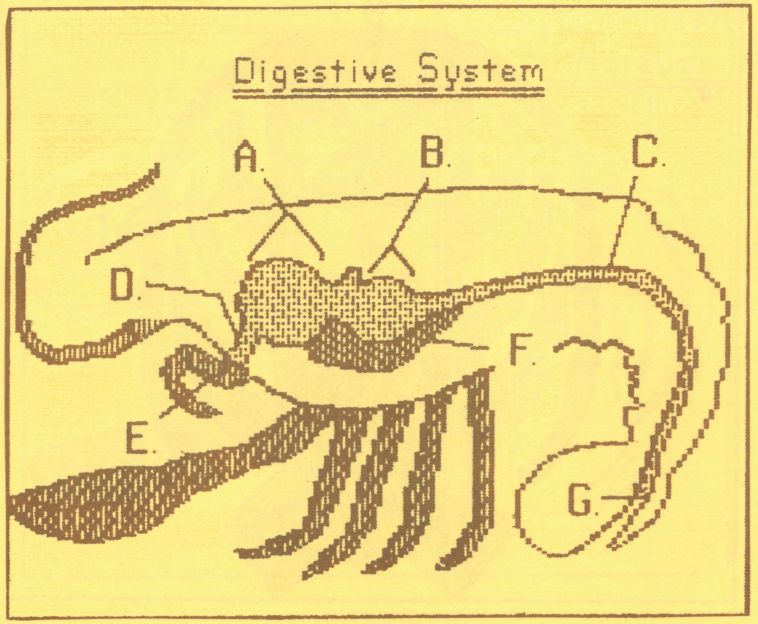
___ 1) The VENTRAL NERVE CORD is letter ...

___ 2) The BRAIN is letter ...

___ 3) The GREEN GLAND is letter ...

___ 4) The GANGLIA are letter ...

PARTS IDENTIFICATION TEST
DIGESTIVE SYSTEM



___ 1) The ESOPHAGUS is letter ...

___ 2) The PYLORIC STOMACH is letter ...

___ 3) The ANUS is letter ...

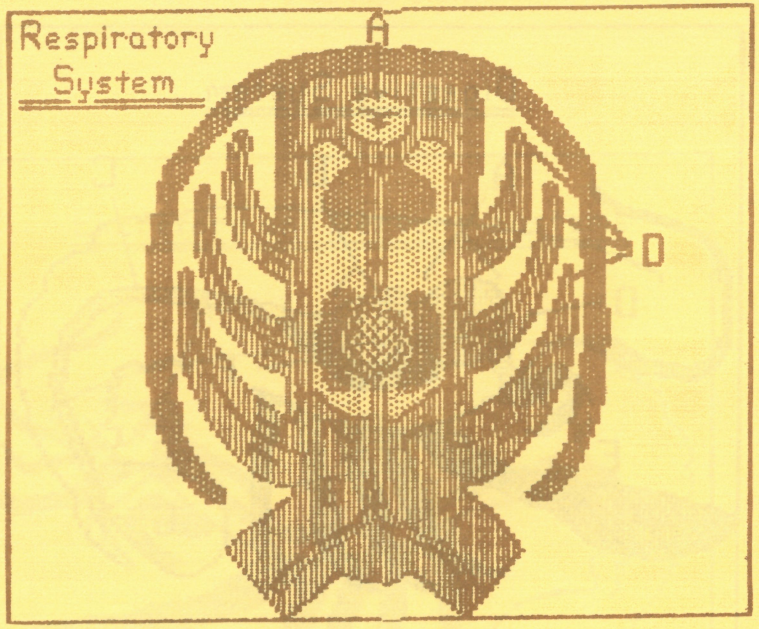
___ 4) The MOUTH is letter ...

___ 5) The CARDIAC STOMACH is letter ...

___ 6) The DIGESTIVE GLAND is letter ...

___ 7) The INTESTINE is letter ...

PARTS IDENTIFICATION TEST
RESPIRATORY SYSTEM



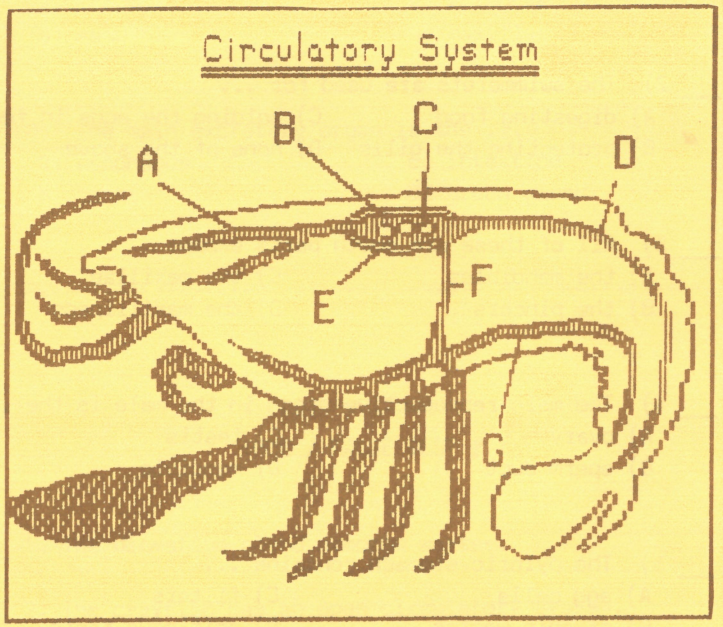
1) The GILLS are letter ...

2) The OXYGEN RICH BLOOD is letter ...

3) The HEART is letter ...

4) The OXYGEN POOR BLOOD is letter ...

PARTS IDENTIFICATION TEST
CIRCULATORY SYSTEM



___ 1) The POSTERIOR DORSAL ARTERY is letter ...

___ 2) The STERNAL ARTERY is letter ...

___ 3) The HEART is letter ...

___ 4) The VENTRAL ARTERY is letter ...

___ 5) The OSTIUM is letter ...

___ 6) The ANTERIOR DORSAL ARTERY is letter ...

___ 7) The PERICARDIUM is letter ...

MULTIPLE CHOICE TEST

___ 1) A crayfish has ...
A) 2 main body sections
B) 3 main body sections
C) 4 main body sections
D) more than 5 body sections

___ 2) The swimmerets are used for ...
A) digesting food
B) protecting the gills
C) holding the eggs in females
D) none of the above

___ 3) All of these are mouth parts except
A) the mandibles
B) the pincers
C) the maxillae
D) the maxillipeds

___ 4) The main reproductive organ in the male is the ...
A) ovary
B) sperm duct
C) testis
D) mandible

___ 5) The pyloric stomach contains ...
A) egg cells
B) organic wastes
C) filters
D) chitinous teeth

___ 6) The holes or valves in the heart ...
A) are called ostia
B) are called pericardium
C) are called arteries
D) are called veins

___ 7) The long appendages on the anterior end of the crayfish are called ...
A) walking legs
B) antennae
C) uropods
D) swimmerets

___ 8) The sac surrounding the heart of the crayfish is called the ...
A) ovary
B) pericardium
C) green gland
D) mandible

___ 9) The fin-like structures on the posterior of the abdomen are ...
A) uropods
B) mandibles
C) antennae
D) maxillae

___10) The main excretory organ is the ...
A) esophagus
B) testis
C) intestine
D) green gland

TRUE / FALSE TEST # 1

___ 1. The digestive gland absorbs wastes.

___ 2. The crayfish has an open circulatory system.

___ 3. Swimmerets are useful to both male and female crayfish.

___ 4. The antenna is used for touch and smell.

___ 5. The walking legs are used for movement.

___ 6. The nerve cord runs along the dorsal surface.

___ 7. The pincers are used for catching food.

___ 8. The exoskeleton is the hard outer shell of the crayfish.

___ 9. To find the telson one should look at the anterior end.

___10. The legs help the gills to move.

TRUE / FALSE TEST # 2

___ 1. The digestive gland secretes enzymes.

___ 2. The veins and arteries are connected in the crayfish.

___ 3. The male crayfish has no swimmerets.

___ 4. The antenna is used for holding food.

___ 5. The walking legs are used for cleaning the body.

___ 6. The nerve cord runs along the ventral surface.

___ 7. The pincers are used for fighting.

___ 8. The exoskeleton is made of chitin.

___ 9. To find the telson one should look at the posterior end.

___10. The swimmerets are attached to the gills.

TRUE / FALSE TEST # 3

___ 1. The digestive gland is part of the digestive system.

___ 2. The crayfish has a closed circulatory system.

___ 3. Swimmerets serve no useful function.

___ 4. The antenna is used for catching food.

___ 5. The walking legs are helpful in mating.

___ 6. The crayfish has a dorsal and ventral nerve cord.

___ 7. The pincers are used for collecting wastes in the blood.

___ 8. The exoskeleton is made of bone.

___ 9. To find the telson one should look under the carapace.

___10. The gills are the main respiratory structure of the crayfish.